

C. If permitted to use COFDM, broadcasters would benefit from a greater capacity for technological improvement

In its field trials, Sinclair selected a COFDM data rate of 18.67 Mbps over its 6 MHz channel, since this data rate permits the provision of HDTV service while ensuring high-quality reception through simple antennas. As described above, however, COFDM allows broadcasters to vary their data rates -- including operations at higher rates -- and this flexibility gives COFDM a greater capacity for technological improvement than 8-VSB.^{39/} In fact, COFDM currently supports 6 MHz data rates as high as approximately 24 Mbps, and, in the foreseeable future, COFDM broadcasters will likely be able to operate at this current maximum or at an even higher rate while offering the same ease of reception seen in the Baltimore tests. This enhanced bandwidth would offer great benefits, enabling COFDM broadcasters to transmit, for example, multiple HDTV programming streams. In contrast, even if 8-VSB broadcasters can someday overcome dynamic multipath effects, they will always be limited to the same fixed, inflexible data rate of approximately 19.4 Mbps.^{40/} This higher technological "ceiling" for COFDM should weigh heavily in favor of a grant of the instant petition.

^{39/} This greater capacity for improved performance has already been demonstrated. Since 1996, when the Commission adopted 8-VSB, COFDM technology has developed continuously and substantially, while 8-VSB performance has remained largely stagnant.

^{40/} The fixed data rate associated with the existing standard will not prevent 8-VSB broadcasters from over time increasing the volume of programming transmitted over their 6 MHz channels; advances in coding and compression technologies will permit some improvement in their service. The improvements in COFDM service, however, will be more rapid and substantial.

D. By permitting COFDM operations, the Commission will allow the marketplace to play an appropriate role in the development of DTV broadcast technology

Sinclair recognizes that in adopting a single ATSC DTV transmission standard, the Commission sought to provide certainty and confidence for manufacturers, broadcasters, and consumers that DTV service would be reliably received all over the country and that the implementation of DTV would be a smooth process. The Commission distinguished DTV broadcasting from other services such as DARS, MMDS, DBS, and PCS, and held that, given the need for such certainty and reliability, it was not appropriate in the broadcast context to rely on market forces to govern the selection of the appropriate transmission standard.^{41/}

The Commission's findings in 1996, however, do not justify its continued exclusive reliance on the 8-VSB modulation standard today. As an initial matter, despite its decision in the *Fourth Report and Order* to adopt 8-VSB as the sole digital modulation technology, the ATSC DTV standard is in fact not a rigid one -- the Commission avoided inflexible standards for numerous other DTV operational parameters. For instance, the Commission did not require broadcasters to use either the interlacing or progressive scanning formats, and broadcasters now have eighteen different scanning options from which to select. Similarly, the Commission did not require broadcasters to adhere to any specific aspect ratios or lines of resolution. Just as the Commission decided to allow the marketplace to determine the optimal service configuration for these various DTV parameters, the Commission should now adopt a similar approach for digital modulation technology, particularly in light of the questions now raised regarding 8-VSB.

Moreover, under any circumstance, an interest in assuring reliability and certainty of DTV service can no longer justify exclusive reliance on 8-VSB technology, since, as shown in this

^{41/} See *Fourth Report and Order* at paras. 34-37.

filing, the 8-VSB standard does not permit reliable reception through simple antennas in broadcasters' core business areas. Given the undeniable development of COFDM as a legitimate (and in Sinclair's view superior) alternative to 8-VSB, the Commission should acknowledge that a more market-based approach is now appropriate in this setting. Instead of choosing a technology "winner" and perpetuating exclusive reliance on the questionable 8-VSB modulation method, the Commission should rely on the marketplace to decide these technologies' future roles in the broadcast industry.

E. A decision by the Commission to permit COFDM operations would accelerate the development of DTV in the United States and speed the recapture of NTSC spectrum

Given the benefits of COFDM technology, a decision permitting COFDM operations would accelerate the development of DTV in the U.S. and further the goals identified by the Commission when it established its DTV implementation milestones.^{42/} Consumers would gain confidence that DTV reception through simple antennas will be reliable and robust, and would likely be attracted to the mobile and portable DTV services made possible by COFDM. In this scenario, consumer acceptance of DTV is likely to spiral upward, with manufacturers increasing investment in DTV equipment and services as a result.

In addition, a COFDM-based U.S. standard would be more compatible with the DTV systems being implemented in a majority of countries around the world, heightening the interest of global manufacturers in the U.S. market.^{43/} Permitting COFDM operations in the U.S. could therefore make a greater variety of DTV products available, lower the price of digital equipment,

^{42/} See *supra* at 7-8.

^{43/} As indicated above, COFDM-based DTV service will be available in at least 300 million TV households around the world.

and further promote the adoption of DTV technology by American consumers.

Greater consumer acceptance of DTV is key to speeding the recapture of the NTSC spectrum and the conclusion of the digital transition period. While there is an ostensible deadline of 2006 for the return of broadcasters' NTSC spectrum, this return is ultimately contingent on sufficient DTV market penetration. Assuming that cable operators are not required to carry all operating DTV stations during the transition,^{44/} until eighty-five percent of the television households in a market have purchased a DTV receiver, broadcast stations in that market will not be required to return their NTSC channels.^{45/} Permitting COFDM operations would assure ease of reception and enable consumers to receive innovative new mobile and portable video services. As a result, the eighty-five percent threshold could be reached much more quickly.^{46/}

^{44/} In the Commission's digital must carry rulemaking proceeding, Sinclair argued that only cable operators with digital capability should be subject to a comprehensive DTV must carry requirement during the DTV transition. Comments of Sinclair Broadcast Group, Inc., CS Docket No. 98-120 (October 13, 1998). Clearly, it is uncertain whether the Commission will require full cable carriage of broadcasters' NTSC and DTV signals during that period.

^{45/} See 47 U.S.C. § 309(j)(14)(B); *Sixth Order on Recon.* at para. 80. In the DTV environment, the receiver can be a set-top box that is distinct from a television set or display device. DTV receivers include (i) set-top boxes that receive digital television signals and permit those signals to be viewed over an enhanced display device, and (ii) set-top boxes that merely convert digital television signals into analog format for viewing on a conventional NTSC receiver. (The Communications Act distinguishes between these receivers at Section 309(j)(14)(B)(iii)(II).) While a DTV receiver and enhanced display device together currently average approximately \$7,000-8,000, a set-top box capable only of digital-to-analog conversion is likely to cost below approximately \$500 when it eventually becomes available.

^{46/} The Congressional Budget Office issued a report in September 1999 which concluded that the transition to DTV is likely to extend beyond 2006, largely based on the uncertainty of digital cable carriage. See "Completing the Transition to Digital Television," Congressional Budget Office, at Chapter III (September 1999) ("*CBO Report*"). This finding clearly highlights the importance of the development of a DTV broadcast service that is attractive to American consumers.

II. Flaws in the 8-VSB Digital Modulation Standard Warrant the Commission's Abandonment of Its Exclusive Reliance on This Standard

A. The ATSC 8-VSB standard does not currently permit ease of reception or reliable over-the-air DTV service to viewers with simple antennas in broadcasters' core business areas

Current problems with the 8-VSB standard should weigh heavily in favor of the Commission's abandonment of its exclusive reliance on that digital modulation standard. As a fundamental matter, the 8-VSB standard presently does not permit adequate over-the-air DTV reception, much less replicate current NTSC service. The *Comparative Study* demonstrates that use of the 8-VSB modulation standard at present does not permit reliable over-the-air reception of DTV through simple antennas in broadcasters' core business areas, in indoor or outdoor environments.^{47/} There was successful reception of Sinclair's 8-VSB signal through a simple dipole antenna at only eleven of the thirty-one test locations within the Grade A contour, and successful reception through a double bow-tie antenna was achieved at only seven of eighteen test sites. Even where the 8-VSB signal was successfully received, only thirty percent of the time could the antenna be rotated as much as 90 degrees without losing reception. *Comparative Study* at 8-9. In comparison, under the same test conditions, COFDM reception could be maintained eighty percent of the time.

^{47/} Proponents of the 8-VSB standard have publicly questioned the validity of Sinclair's field trials. In fact, the *Comparative Study* represents the most comprehensive analysis to date of the relative performance of COFDM and 8-VSB signals over 6 MHz channels under real-world conditions, and provides the most accurate data available on the reception of these DTV signals with simple antennas. As such, this study should be given full weight by the Commission as it considers the instant petition. In contrast, previous tests utilizing ATSC-based methodology should be dismissed by the Commission as irrelevant, since those tests, conducted in Charlotte, NC and elsewhere, tested the performance of the 8-VSB signal when received by a 30-foot, highly directional outdoor antenna -- unrealistic conditions for the average American consumer.

Unfortunately, there is currently no adjustment that a broadcaster can make to its 8-VSB transmissions to ameliorate these reception problems. In particular, an increase in transmission power would not only fail to resolve these reception problems, it would likely exacerbate complex multipath effects within a broadcaster's core business area.

B. It would be unsound policy for the Commission to require consumers to receive DTV through a technology other than a simple antenna

Given the reception difficulties described above, it is likely that continued exclusive reliance on the 8-VSB modulation standard would force consumers to access broadcast DTV through some means other than a simple antenna. Such an approach would be unsound communications policy and would have harmful effects both during and after the DTV transition period.

1. Such policy would jeopardize the DTV transition

As mentioned above, assuming that cable and DBS carriage of broadcasters' DTV signals is not comprehensive, broadcast stations will not be required to return their NTSC channels until eighty-five percent of the television households in their markets have purchased a DTV receiver. If Commission policy precludes the reception of DTV with a simple antenna, consumers are unlikely to purchase and deploy DTV receivers in sufficient numbers, and this eighty-five percent digital threshold is unlikely to be passed, if at all, for many years.^{48/}

As indicated above, U.S. consumers today do not expect to deploy complicated or time-consuming peripheral installations, such as a thirty-foot mast-mounted rooftop rotor antenna,

^{48/} While Sinclair is pessimistic about the outcome of the DTV transition if the Commission maintains its exclusive reliance on the 8-VSB standard, Sinclair will initiate 8-VSB operations, as indicated above, in full compliance with the Commission's DTV implementation deadlines.

when they purchase a television^{49/} Once consumers become aware that their substantial expenditure on a digital receiver and display device will not assure high-quality DTV service, the general uncertainty surrounding this new technology will likely limit DTV penetration.

While some proportion of consumers will no doubt be open to installing a large outdoor antenna, the limited viewing functionality offered by 8-VSB DTV service in some television markets will deter many from making this investment. Specifically, in markets with non-collocated DTV stations,^{50/} outdoor antennas must have rotating capability in order to achieve adequate reception of 8-VSB signals. As a result, instead of enjoying the instantaneous channel surfing common to most TV households today, a viewer relying on a rotor antenna will have to tolerate up to a thirty-second delay in reception while his or her antenna rotates from one channel position to another.^{51/} Reliance on this technology will also inhibit VCR usage,^{52/} and will render inoperable the "Picture-In-Picture" ("PIP") feature, a popular consumer accessory in television

^{49/} The need for such equipment in the DTV context is no surprise to the manufacturing community, however, with CEMA earlier this year launching its "TV Antenna Selector Map Program." With this program, CEMA makes available special color-coded maps, for all 211 designated market areas, indicating what kind of antenna is necessary throughout these TV markets in order to achieve adequate DTV reception. Clearly, potential DTV purchasers at retail outlets utilizing these CEMA maps will quickly become aware that 8-VSB DTV service cannot be received through a simple, consumer-grade antenna. In fact, discussing this program in May 1999, CEMA President Gary Shapiro conceded that "antennas may be the only way for consumers to receive the sensational picture quality and digital surround sound of a high-definition television (HDTV) signal until the local cable system passes through HDTV signals." *Electronics Now* (May 1999), at 16.

^{50/} Technical, environmental, and commercial factors will prevent the collocation of DTV transmitters in a significant percentage of television markets.

^{51/} Rotor antennas typically rotate at approximately six degrees per second, with stations potentially oriented as far as 180 degrees apart.

^{52/} Using rotor antennas, viewers will no longer be able to view programming on one channel while recording programming aired on another station. On average, fifteen percent of program recordings are made while viewers are watching a different channel. See *TV Dimensions '99*, Media Dynamics, Inc., at 153 (1999) ("*TV Dimensions*").

sets. Clearly, the similarity of 8-VSB viewing in these markets to 1950's- and 1960's-era TV viewing is inconsistent with the Commission's general commitment to the deployment of advanced communications technologies, and will clearly limit consumer enthusiasm for this new service.^{53/}

In addition, whatever the nature of the TV market, not all television households will even be able to deploy a large outdoor antenna. Millions of viewers living in multi-unit dwellings or in other forms of shared housing, particularly in urban areas, will not have access to the necessary rooftop space. In addition, some consumers (most likely those viewing DTV programming on an analog television set through a digital-to-analog converter box) may not be able to afford the expense associated with a professionally-installed outdoor rooftop antenna, which typically costs approximately \$300 with installation, with an additional \$100 for rotor capability.^{54/}

In contrast, if the Commission permits broadcasters to operate using COFDM, U.S. consumers are much more likely to invest in a DTV receiver. Viewers in broadcasters' core business areas would enjoy ease of reception and reliable over-the-air service through simple antennas, eliminating the need for an outdoor antenna system, and these consumers would be free from the functional limitations resulting from exclusive reliance on 8-VSB.^{55/}

^{53/} See, e.g., Report in the Matter of Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, CC Docket 98-146, FCC 99-5 (released February 2, 1999).

^{54/} Households with two or more television sets receiving broadcast service only would need a separate rotor antenna for each of those sets (assuming that viewers in those households want the ability to watch different stations simultaneously on multiple sets). Currently, almost 75% of all TV households in the U.S. own two or more television sets, and the average television household in the U.S. owns 2.4 television sets. *TV Dimensions* at 18.

^{55/} If the Commission permits broadcasters to use COFDM technology, consumers with
(continued...)

2. Even after the DTV transition, continued reliance on the 8-VSB standard would diminish viewing functionality and impose unnecessary costs on U.S. consumers

If the DTV penetration threshold is somehow met despite continued exclusive reliance on the 8-VSB standard, maintenance of that policy will have detrimental effects even after the DTV transition. First, the diminished viewing functionality described above would likely persist into the post-transition period. Broadcast consumers in markets without collocated DTV stations would no longer be able to channel surf as they did in the NTSC environment, and, in addition, both VCR usage and use of the PIP feature would be severely impacted.

Maintenance of the status quo would also impose unnecessary costs on broadcast consumers. Almost one-quarter of the approximately 99 million TV households in the U.S. still receives television service exclusively through local broadcasting.^{56/} In addition, even in those television households that subscribe to cable, approximately twenty percent of all television sets in use receive broadcast service only.^{57/} If the Commission does not permit COFDM operations, these existing broadcast viewers will be forced to rely on either a large outdoor antenna or a cable or satellite subscription in order to maintain their current television viewing habits. Any of these options constitutes a significant expense. As mentioned above, a typical outdoor antenna, with

^{55/} (...continued)
simple indoor antennas will actually be able to receive DTV through their existing hardware. In this scenario, consumer inconvenience and the need to obtain new equipment will be minimized.

^{56/} Approximately sixty-eight percent of all television households in the U.S. subscribe to cable service. *TV Dimensions* at 110. Approximately ten percent of U.S. households currently receive service from a DBS operator or some other multichannel video provider. See *CBO Report* at Summary, Table 1. At present, however, DBS service does not include local and network broadcast programming.

^{57/} While cable households have an average of 2.9 working television sets, only 2.3 of these sets on average are connected to the local cable system. *TV Dimensions* at 112.

installation, costs between \$300 and \$400. Nationally, cable service costs an average of approximately \$25-30 per month, with a \$25-35 average minimum installation charge, while DBS installation on average costs between \$100 and \$200, with an average monthly service charge of approximately \$25 per month.^{58/}

While these costs would no doubt frustrate most broadcast consumers, such expenses would be particularly burdensome for lower-income television households. Not only do such households have the least disposable income, they also reside to a disproportionate extent in urban areas, where severe multipath conditions will make 8-VSB reception most problematic.^{59/} As a result of these factors, at the conclusion of the DTV transition, many of these consumers may lose the ability to receive television service in their homes.

By forcing millions of television households to subscribe to cable or satellite service, a Commission decision to maintain exclusive reliance on the 8-VSB standard would jeopardize the viability of free, local over-the-air broadcast television. The preservation of free over-the-air local broadcasting has long been a goal of both the Commission and Congress;^{60/} such service plays an

^{58/} See NCTA Factbook (1998). Overall, assuming the validity of the ATSC DTV model in which broadcast households accept the need for outdoor antennas -- causing cable and satellite service to fall short of ubiquity -- continued exclusive reliance on 8-VSB could cost American consumers as much as \$50 billion.

^{59/} Low-income households also rely on local broadcasting service to a disproportionate degree. While cable penetration in the U.S. overall is 68%, such penetration is only 64% among television households with less than \$30,000 annual income, and only 50% among television households with less than \$20,000 annual income. *TV Dimensions* at 112.

^{60/} Just last year, the Commission stated in the DTV proceeding that its goal in revising certain DTV policies was "to preserve and promote free, universally available local broadcast television in a digital world." Second Memorandum Opinion and Order on Reconsideration of the Fifth and Sixth Report and Orders, 14 FCC Rcd 1348 (1998). In addition, in enacting must-carry legislation in 1992, Congress' overriding objective was "to preserve access to free television programming for the 40 percent of Americans without cable." See *Turner Broadcasting System, Inc. v. FCC*, 114 S. Ct. 2445, 2445

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important role in a free, democratic society, allowing all citizens to obtain information on policy issues and political candidates, and is a key part of the national and local public safety communications system during emergencies.^{61/} By facilitating ease of reception and reliable over-the-air DTV service through simple antennas under real-world conditions, the use of COFDM would assure the continued viability of free local broadcasting as an independent means of distributing television programming.

III. There Are No Legitimate Technical or Economic Reasons to Preclude Broadcasters From Operating Using COFDM Technology

A. There is no legitimate technical reason precluding use of COFDM modulation technology

In recent months, various parties favoring continued exclusive reliance on the 8-VSB modulation standard in the U.S. have questioned certain aspects of COFDM performance. In particular, they have argued that (i) use of COFDM technology does not permit the provision of HDTV service over a 6 MHz channel, and (ii) COFDM signals provide considerably less coverage than 8-VSB transmissions. Proponents of the existing 8-VSB standard have also claimed that the multipath problems currently plaguing 8-VSB reception will be resolved by future improvements in this technology. These claims are either naive, erroneous, or irrelevant, and do not provide a

^{60/} (...continued)
(1994).

^{61/} In maintaining a broadcast-based system for emergency alerts in 1995, the Commission noted that radio and television broadcast stations currently reach nearly every part of the U.S., often with several stations. *See* Report and Order and Further Notice of Proposed Rulemaking, 10 FCC Rcd 1786, para. 29 (1995). In contrast, if such emergency alerts were transmitted only through cable or satellite systems, this crucial public safety information would be received only by subscribers to these systems, and would not be universally available; in particular, households without the financial means to subscribe to these systems would lose access to this information. In addition, the resilience of broadcast communications is crucial in public safety emergencies, given that wired communications services typically are more easily disrupted in such situations.

legitimate basis for maintaining the status quo.

1. COFDM signals can be used to provide HDTV over 6 MHz channels

As discussed above at 17-18, contrary to assertions from 8-VSB proponents, COFDM signals can be used to provide HDTV over 6 MHz channels. It is generally recognized that HDTV service can be provided over data streams of 18 Mbps or more, and, as discussed above and in the attached report, Sinclair transmitted its COFDM signal at a data rate of 18.67 Mbps. *See Comparative Study* at 3. In addition, the greater capacity for improvement of COFDM technology will likely permit high-quality reception at even higher rates in the near future.

While it is true that the 8-VSB standard currently permits a data rate approximately four percent greater than that tested by Sinclair for COFDM, the 8-VSB data rate is fixed and will inevitably be exceeded by a COFDM rate that is easily receivable. Moreover, any existing rate advantage for 8-VSB is rendered irrelevant by the fact that a significant percentage of television households cannot achieve reliable over-the-air reception of 8-VSB signals.

2. The greater coverage predicted for 8-VSB signals in a laboratory environment does not hold up under real-world conditions

At equivalent power levels, assuming laboratory conditions (gaussian channels with no other impairments), the 8-VSB standard may appear to permit greater signal coverage than COFDM, since 8-VSB signals can be decoded at power levels below the decoding threshold for COFDM. As an initial matter, however, Sinclair's tests demonstrated that in a real-world environment, include complex multipath conditions, this difference decreases to 2 dB. *Comparative Study* at 16. More importantly, under the same real-world conditions, this 2 dB difference does not lead to any material difference in the receivability of the 8-VSB and COFDM signals. As indicated in the *Comparative Study*, at the nine test locations at the fringe of the

signal coverage area, the quality of COFDM and 8-VSB reception was shown to be equivalent.

See Comparative Study at 15.

In any event, COFDM broadcasters could compensate for any initial loss in coverage by increasing their power consistent with new COFDM maximization procedures developed by the proposed COFDM Task Force. Such increased power should enable the vast majority of COFDM broadcasters to provide high-quality service to their Grade B perimeters.

For the very small percentage of TV households at the Grade B fringe that may be unable to obtain high-quality COFDM reception, such reception can be ensured through the purchase and deployment of a preamplifier. (On average, a preamplifier costs approximately \$35.) In contrast, there is no reasonable technological solution for the urban viewer whose location suffers from multipath distortion. Short of deploying an expensive rooftop antenna or subscribing to cable, urban households relying on simple antennas will be powerless to overcome 8-VSB multipath effects.^{62/}

3. The Commission should not maintain exclusive reliance on the 8-VSB standard on the basis of speculated improvements in 8-VSB receiver technology

In recent months, various entities with a vested interest in 8-VSB technology have suggested that improvements in 8-VSB will soon resolve the reception problems described by Sinclair. Any claim that such improvements will allow 8-VSB to overcome dynamic multipath conditions are mere speculation, however, and in the absence of specific and identifiable consumer products that achieve these results, such promises cannot serve as the basis for the Commission's

^{62/} As indicated above, an increase in the power level of an 8-VSB signal will not resolve the multipath problems that prevent reliable reception of that signal by a simple, consumer-grade antenna. In fact, under certain conditions, such an increase will exacerbate these multipath effects.

continued exclusive reliance on 8-VSB.

In any event, even if 8-VSB is significantly improved, Sinclair understands that it is highly unlikely to permit omnidirectional reception, and it is also generally recognized that 8-VSB technology will not be able to match the performance of COFDM in a mobile or portable environment. Moreover, any such improvements will be far exceeded by advances in COFDM technology, and DTV systems using COFDM will remain superior across all relevant reception environments.

B. Broadcasters, manufacturers, and consumers would incur only minor costs if the Commission decided to permit use of COFDM in the U.S.

1. Any additional costs for broadcasters would be borne voluntarily, and would likely be inconsequential

As indicated above, Sinclair is not asking the Commission to replace the 8-VSB standard with COFDM or otherwise mandate the use of COFDM. If the Commission grants the instant petition, broadcasters will be free to operate using the 8-VSB standard, and only those broadcasters that voluntarily choose to use COFDM will incur any new costs as a result of this decision.

Some observers have recently argued that broadcasters using COFDM technology will incur exorbitant power costs. In particular, Harris Corporation (“Harris”) asserts that, in order to overcome both the theoretical 3 dB decodability gap between 8-VSB and COFDM signals and a difference in the technologies’ peak-to-average power ratio, COFDM broadcasters will have to operate at four times the power level of 8-VSB broadcasters. Harris’ analysis is incorrect. First, as stated above, the theoretical decodability gap between 8-VSB and COFDM in real-world conditions narrows to just 2 dB today, and, as shown by Sinclair’s tests, this 2 dB difference does not result in a practical difference in reception coverage under those same real-world conditions.

In addition, as discussed in reports reflecting the ongoing technological development of COFDM,^{63/} Harris' claims regarding the peak-to-average power ratio of COFDM will in all likelihood be made irrelevant by recent developments in COFDM technology.

Even if Harris' assumptions are accepted for the sake of argument, the Commission's DTV power maximization rules will moot these concerns much of the time. Many DTV broadcasters in the UHF band will no doubt increase their power levels from their current allotment to almost 1000 kW, as permitted under the Commission's rules, and a broadcaster transmitting at such a high power level will provide a strong signal to the horizon no matter which digital modulation technology is used. Accordingly, in these instances, a broadcaster's power level and transmitter size will be unaffected by its choice of digital modulation technology.

Thus, Sinclair does not believe COFDM operations will lead to any significant increase in broadcasters' average utility costs or other operational expenses. Rather, the transmitter modifications necessary to broadcast COFDM signals will likely cost only \$50,000 on average, and such modifications should not be technically burdensome or complicated. In addition, Sinclair's Baltimore tests showed that, if a broadcaster maintains a single digital transmitter facility, it will be able to switch easily between COFDM and 8-VSB operations.

^{63/} Xianbin Wang, T.T. Tjhung, and C.S. Ng, "Reduction of Peak-to-Average Power Ratio of OFDM System Using a Companding Technique," IEEE Transactions on Broadcasting, Vol. 45, No. 3, September 1999.

2. Grant of the instant petition would not impose significant costs on DTV receiver manufacturers

Sinclair believes that any DTV receiver manufacturer wishing to make its receivers compatible with COFDM technology will be able to do so at little cost. There are presently more than 450,000 COFDM receivers in service today in the U.K. and Europe, more than one hundred times the number of 8-VSB receivers that have been sold in the United States over an almost identical period. In light of the economies of scale resulting from this widespread adoption of COFDM, it appears that the necessary equipment and expertise are available to incorporate this technology into DTV receivers in the U.S. at minimal expense. In fact, Sinclair understands that a number of DTV receiver manufacturers are already producing or will soon produce DTV receivers that are compatible with multiple modulation standards, including receivers that can receive COFDM signals; it appears that these companies should be able to supply 8-VSB/COFDM television sets to the U.S. marketplace at little additional cost.

3. The prior sale of 8-VSB receivers to consumers should not prevent the Commission from permitting broadcasters to use COFDM technology

Sinclair understands that approximately three to four thousand 8-VSB DTV receivers have already been sold to U.S. consumers.^{64/} These purchases, however, should not prevent the Commission from permitting broadcasters to use COFDM technology. Given the size of the U.S. television market, the number of consumers who have purchased a DTV set is insignificant -- this group represents only four thousandths of one percent of all U.S. television households. The Commission should not foreclose the benefits of COFDM in order to protect this tiny fraction of

^{64/} This figure includes only sales of DTV receivers to consumers. A larger number of DTV display devices has been sold, both to retail outlets and consumers, but without any tuning component these sets can be used only in conjunction with a separate source of video programming.

consumers. Moreover, even if the Commission grants Sinclair's Petition, these viewers will still potentially have access to DTV broadcast programming, since broadcasters will remain free to transmit an 8-VSB signal.

IV. The Next Step: An Order Establishing That Broadcasters Will Be Permitted to Operate Using COFDM Technology, and the Creation of a COFDM Task Force

For all of the reasons described above, the Commission should expeditiously issue an order establishing that U.S. broadcasters will be permitted to transmit their DTV signals under a COFDM-based alternative ATSC DTV standard. To facilitate COFDM operations by U.S. broadcasters, the Commission should appoint an industry task force ("COFDM Task Force") that would (i) conduct a study and issue recommendations to the Commission regarding the integration of COFDM digital modulation technology into the ATSC DTV standard, and (ii) conduct a rigorous scientific analysis to determine the interference ratios for COFDM transmissions into existing NTSC and 8-VSB DTV signals. In light of the narrow, well-defined scope of these responsibilities and the preexisting technical literature on these issues, the Commission should require that the Task Force complete its analysis and issue its recommendations and findings within 120 days of its appointment. Once the Task Force has performed these duties, the Commission should review its recommendations and adopt an alternative, COFDM-based ATSC DTV standard, and establish simple procedures whereby broadcasters could demonstrate, using the interference ratios provided by the COFDM Task Force, that they will not cause interference to any operating NTSC or 8-VSB DTV broadcasters. Once a broadcaster has made this interference showing, it would be permitted to initiate COFDM operations.

Given broadcasters' urgent need for flexibility in the choice of digital modulation standard, Sinclair urges the Commission to take expeditious action throughout the course of this

proceeding, from the placement of the instant Petition on public notice until its final action on the findings and recommendations of the proposed Task Force.


Conclusion

For all of the aforementioned reasons, Sinclair respectfully urges the Commission to modify its DTV modulation standard and authorize broadcasters to operate under a COFDM-based alternative ATSC DTV standard.

Respectfully submitted,

SINCLAIR BROADCAST GROUP, INC.

FISHER WAYLAND COOPER
LEADER & ZARAGOZA L.L.P.
2001 Pennsylvania Avenue, N.W.
Suite 400
Washington, D.C. 20006
(202) 659-3494

By: 
Martin R. Leader
Stephen J. Berman
David S. Konczal
Brendan Holland

Its Attorneys

Dated: October 8, 1999

EXHIBIT A

Comparative Reception **Testing of 8VSB and COFDM** **In Baltimore**

Nat Ostroff, VP New Technology, Sinclair Broadcast Group

E-mail: nostroff@sbgnet.com

Phone: (410) 568-1569

Mark Aitken, Advanced Technology Group, Sinclair Broadcast Group

E-mail: maitken@sbgnet.com

Phone: (410) 662-1425



www.sbgnet.net

Comparative Reception Testing Of 8VSB and COFDM in Baltimore

By:

Nat Ostroff, VP New Technology, Sinclair Broadcast Group
Mark Aitken, Advanced Technology Group, Sinclair Broadcast Group

ABSTRACT

This paper presents the results of a series of investigative Digital Television (DTV) reception tests that were performed in the Baltimore television market during the months of July and August 1999. The tests were designed to compare the ease of reception between the ATSC 8VSB modulation standard, and the DVB-T COFDM modulation standard using receivers that were available to the industry and the consumer at the time. Both systems were operated in a standard 6MHz United States channel allocation. The COFDM parameter chosen allowed the COFDM based system to deliver 18.67Mb/s. This was judged to be comparable to the 19.39Mb/s data rate of the 8VSB system. Common antenna, transmission and receive systems were used throughout the testing. The transmitter was switched by remote command between COFDM and 8VSB. Under both conditions, the average power was maintained to be the same value.

Complete reception parameters were recorded at 40 sites, and partial data from another 30 sites. The parameters recorded included spectrum, fade margins to loss of picture, signal strengths and antenna orientation requirements. The antenna pointing angle variation, which is possible before the loss of decoding capability for each system, is developed as a measure of "ease of reception" at each site. Site locations were chosen to represent both "Near-field" (within the Grade A contour of the related NTSC station) and "Far-field" reception (the edge of the Grade B contour of the related NTSC station). Indoor locations as well as outdoor locations using simple receive antennas were chosen for the "Near-field". Outdoor locations using moderate gain directional antennas were chosen for use in the "Far-field".

Comparative Reception Testing Of 8VSB and COFDM in Baltimore

By:

Nat Ostroff, VP New Technology, Sinclair Broadcast Group
Mark Aitken, Advanced Technology Group, Sinclair Broadcast Group

1.) Introduction

Broadcasters have always been distinguished from other “content providers” (satellite, cable, MMDS and others) by the fact that their “product” is distributed as a ubiquitous wireless service. It is in fact, truly “broadcast” into a market. In the transition to Digital Television, a multiplicity of new services and capabilities have been made available to broadcasters. These new possibilities have been used to encourage broadcasters to make the investment required to transition to DTV. Inclusive in the list of possibilities is HDTV, Interactive TV and other services, multi-channel SDTV, data services and web services. More importantly, the promise of being able to offer these capabilities to a wide variety of portable and mobile devices has become essential to the broadcaster’s ability to compete effectively.

The Sinclair Broadcast Group (SBG) has conducted a series of tests to determine the viability of the current ATSC 8VSB modulation standard, particularly in relation to its “ease of reception” within urban environments. SBG is concerned about indications that “replication of coverage”, as promised by the ATSC and other organizations, has been severely compromised. Replication of signal strength coverage does not necessarily provide replication of service area. Early tests by Sinclair and others¹ had indicated that signal strength alone did not guarantee reception. This test effort was dedicated to raising the visibility of this potentially major obstacle to the DTV rollout in the United States.

Given the simultaneous “roll-out” of DTV in the US and the UK, and having witnessed many problems in indoor receiving environments in another US city², SBG decided to use COFDM in the tests to provide a comparative benchmark for “ease of reception” in typical DTV environments. For the record, SBG is not committed to any specific modulation standard, except for one which truly provides robust “replication of coverage” as is required for our industry’s successful conversion to digital. Furthermore, SBG was fully aware that the receivers used for both COFD and 8VSB, while being offered to the public, may not represent the best that could be built. In fact, they were all that were available to the public and these same ATSC units continue to be sold today as “DTV Ready” receivers compliant with CEMA’s expectations.

¹ Field tests conducted by/for Jefferson Pilot in Charlotte, N.C., NBC in Washington, D.C., WCBS in N.Y. (and others)

² Addendum A, Sinclair Philadelphia Test

2.) Goal of the Testing Program

The goal of the testing program was to determine the “ease of reception” for DTV using two modulation technologies, at both near-field (inside NTSC Grade A) and far-field (edge of NTSC Grade B) reception locations. The ATSC 8VSB single-carrier standard and DVB-T COFDM multi-carrier standard were broadcast alternately on the same channel, at the same average power, in the same 6MHz bandwidth, through the same transmission system, and received/demodulated then displayed on the same monitor. The authors and engineers who conducted the tests well understand that operating at the same average power may provide a theoretical advantage of 3-5dB for 8VSB. However, to simplify the testing activities and provide a definable playing field for 8VSB systems, equal average powers were deemed acceptable.

Many reception tests have been conducted in several U.S. cities, all using a methodology which appears to ignore the broadcaster’s requirement of providing data on the “ease of reception”. Almost every digital test conducted and published to date has attempted to replicate the methods developed by the ACATS WPII Field Test Task Force, which tends to ignore the realities of consumer reception today. Today’s realities require the ability to receive multiple signals from different locations using simple, indoor psuedo omnidirectional antennas. Any protocol that employs a directional Yagi mounted atop a 30-foot tower is in itself contrary to any definition of “ease of reception”.

A primary objective was to determine reception capabilities using simple receiving antennas (bow-tie dipole and double bow-tie reflector) as defined by CEMA ³. Using the indicated antennas, and the limited variety of ATSC 8VSB and COFDM 6MHz DTV receivers available at the time of these tests, various receiving parameters were noted ⁴ and analyzed.

3.) Sinclair Field Test Overview

A Special Test Authority (STA) was obtained to use our DTV allotment (Channel 40) for the tests. A transmission facility was set-up at the future site for this channel, co-located with the current WBFF-TV45 NTSC service and its future DTV (Channel 46) allocation. The choice of Channel 40 over Channel 46 was made to avoid corrupting the data by specific receiver related adjacent channel performance issues. This facility was operated at a DTV ERP of 50kW for both modulation systems, the power level allocated by the FCC ⁵.

A portable reception system was put together that allowed easy transport into remote locations (indoors and outdoors). This system was comprised of currently available DTV receivers, 2 (two) for ATSC 8VSB (Pioneer and Panasonic) and 2 (two) modified for 6MHZ DVB-T COFDM (Nokia and NDS), and a common multi-format monitor. Efforts were made to obtain the latest receiver products for the ATSC system, but nothing

³ http://www.cemacity.org/antenna_Maps/index.htm

⁴ Appendix A, Site Measurements and Notes

⁵ FCC, “Table of Allotments”

beyond current consumer grade were available at the time of the tests. As for the COFDM receivers, the NDS unit was a 2 year old professional grade unit, and the Nokia unit was based on first generation DVB-T consumer product.

Forty (40) sites in and around the licensed coverage area were selected, and complete data gathered. The sites were located within the main-beam of the directional DTV transmitting antenna, and inside of the NTSC defined Grade A service contour⁶. Nine(9) of the sites were located outside of the Grade A contour, in locations considered to be fringe and deep-fringe coverage areas. Every attempt was made to ensure data integrity, including daily receiver and transmitter calibration checks both before and after data collection.

Chart 1 details the system operating parameters chosen for this test. The COFDM parameters were chosen to closely approximate the ATSC 8VSB data rate (19.39Mb/s), while offering a high probability of robust simple antenna reception for COFDM (18.67Mb/s) in the same 6MHz bandwidth.

System	DVB-T	ATSC
Bandwidth	6MHz	6MHz
Carriers	1705	Single
Modulation	64QAM	8VSB
Guard Interval	1/8	~
FEC	3/4	2/3
Useful Data Rate	18.67 Mb/s	19.39 Mb/s

Chart 1

Transmission Facility

A portion of Sinclair's WBFF-FOX 45 transmission site was converted for the DTV transmission facility. (*Figure 1) This refitting required the conversion of a single IOT HPA assembly to DTV operation. SBG acquired from Rhode & Schwartz the DVB-T system that was used for the 6MHz COFDM mobile tests at the NAB'99 convention. This system functioned as the core "on-channel" exciter/driver for both the 8VSB as well

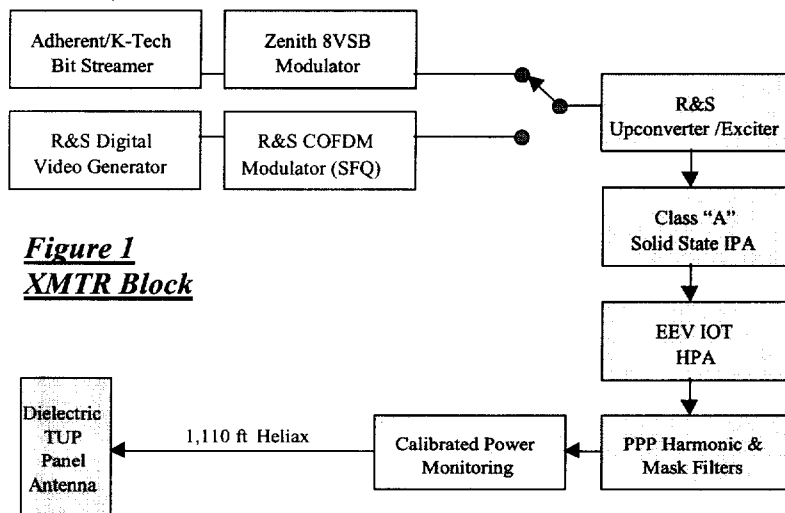


Figure 1
XMTR Block

as COFDM signals. 8VSB modulation was generated by a Zenith 8VSB modulator, whose output was inserted into the upconverter/exciter portion of the R&S equipment, thus enabling the ability to switch between 8VSB and COFDM as required. The Zenith modulator supported linear and non-linear equalization for full ATSC compliance. A

Rhode & Schwartz (R&S) SFQ modulator generated the COFDM modulation, which was fully configurable for all of the documented DVB-T modes of operation.

⁶ Appendix B, EDX 50/50 "Contour Map" of existing WBFF-TV45 system

The on-channel RF output of the R&S exciter was passed through a 400 watt solid state Class "A" IPA to provide the required "clean" drive to an EEV IOT rated at 45kW peak in NTSC common-mode amplification operation. The RF output of this IOT (~6kW AVG.) was passed through an RF Mask filter (Andrews/Passive Power Products) designed for ATSC requirements. The final output of this system was 5.5kw AVG.

The amplified DTV signals were passed through an ~1,100 foot run of semi-flexible heliax, delivering the required power to a Dielectric TUP2-1A-2P broad-band panel antenna for an ERP of 50kW DTV AVG. This directional antenna panel array was side mounted below the WBFF-TV45 top-mount main transmission antenna and oriented towards the south over downtown Baltimore. A complete list is available which details the primary equipment used in these tests ⁷.

Receiving System

A tripod was used to mount the receiving antennas used in the various phases of testing (dipole, bow-tie array, Yagi) in differing environments. For the "Near-field" arrangement (*Figure 2), the output of the receiving antenna was passed through a Low Noise Amplifier with its gain adjusted to present to the receivers a normalized (0dB) input (as if the antenna was directly connected to the RF antenna input). This allowed for the losses of cabling, switches, matching transformers, variable attenuators, to be overcome. The use of the variable attenuator allowed a precise determination of thresholds in a variety of configurations and environments.

For far field measurements, the variable attenuator should be placed between the receiving antenna and the LNA to set the noise factor for the system (*Figure 3). In this configuration, the gain (~20.6dB) and noise figure (~2.7dB) of the LNA overcome variables that could result from poor noise figure performance of any of the receivers.

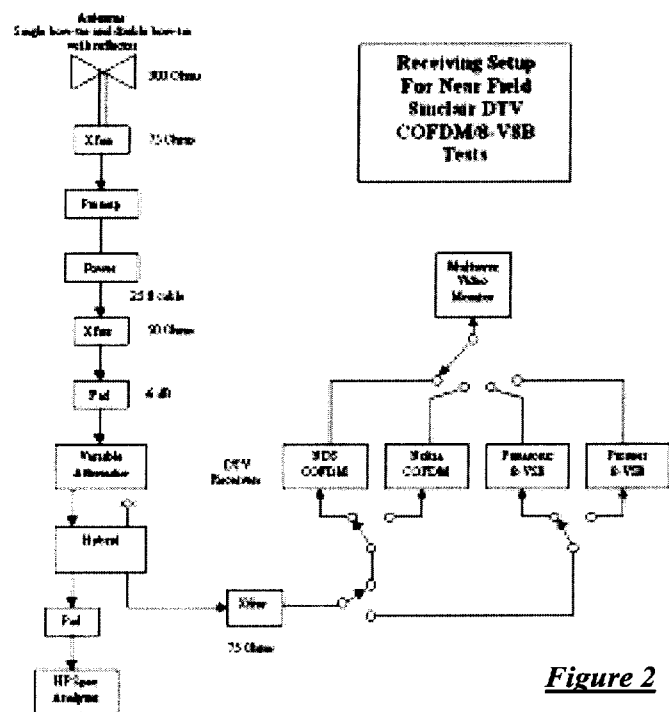


Figure 2

The receiving system was configured for mobility and transportability. Stacked in one rack, mounted atop a rugged wheeled carrier, were all 4 (four) DTV receivers. These

⁷ Appendix C, Test Equipment List

receivers had their RF antenna inputs feed through a mounted switch array that allowed each receiver to be fed independently from the equalized antenna system (described above). As well, each receiver's video/display output was passed through a switch array, which feed a multi-mode monitor, similarly rack mounted. This allowed the display of picture content.

Field Test Plan

Detailed transmitter calibration was performed prior to each day's testing⁸. This calibration noted multiple power measurements, frequency and transmitted spectrum as well as SNR and Error Vector Magnitude (EVM) performance. The portable test system and receivers were calibrated and measurements made noting reference power and receiver sensitivity thresholds. Measurements were made with the same cables employed in the field test system, and the equipment located inside of the mobile van. This same calibration was performed after each day's data collection.

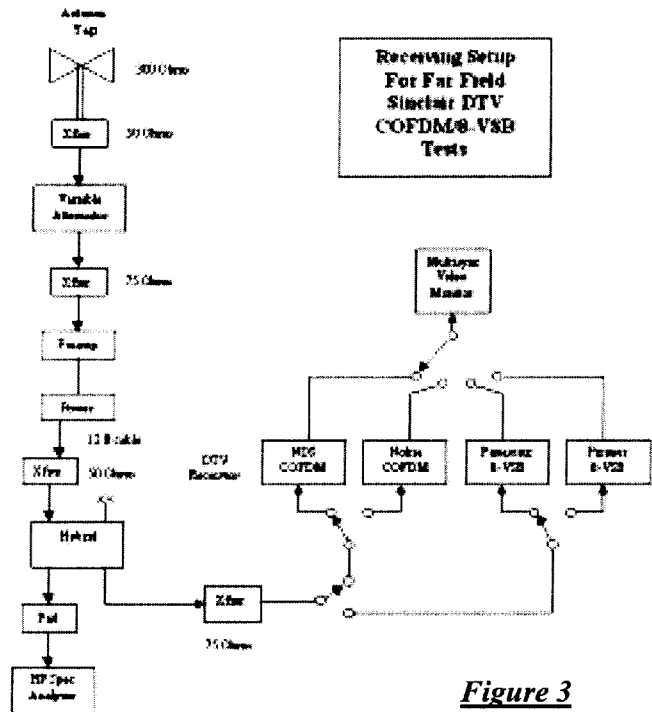


Figure 3

There were three major classes of reception sites: indoor/near-field, outdoor/near-field and outdoor/far-field.

In most indoor sites, the equipment, mounted on portable luggage carriers, was physically wheeled into the home-receiving environment. (*Figure 4) The antennas, mounted atop a 5-foot tripod, were placed in what could be considered typical receiving locations. From this location, receivability parameters for both 8VSB and COFDM were gathered using both simple antenna types. A major parameter noted for each measurement was the orientation sensitivity of the receiving antenna. This was judged to give a relative measurement of the ease of reception.

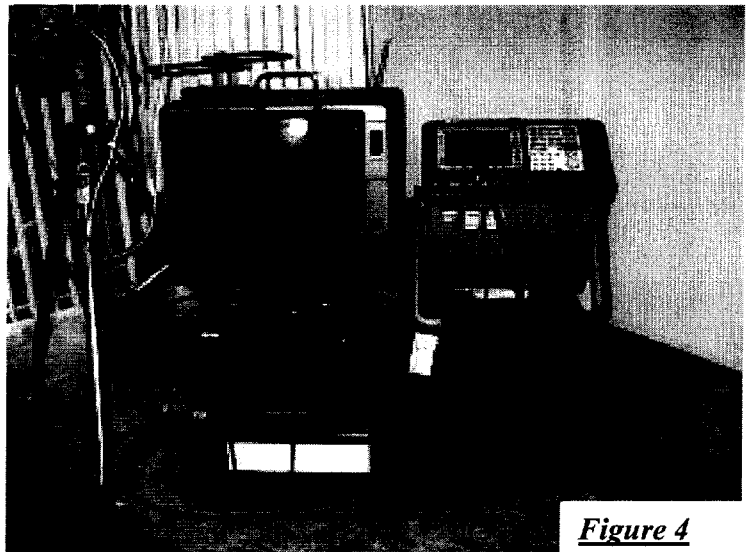


Figure 4

⁸ Appendix D, Daily Transmitter Site Measurements